Implementation Of SABSOON

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LONG-TERM GOALS

We seek to develop an interdisciplinary real-time coastal ocean observing network that will provide users with continuous information on coastal ocean conditions. A number of applications are envisioned. Resource managers and the weather service will use the monitoring data to better predict and manage the use of the South Atlantic Bight (SAB) coastal waters. Academic researchers will use

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the network for targeted research and as a test bed for sensor development. The network can also serve as the nucleus of an observing system that will provide in-situ observations for a nowcast/forecast regional coupled ocean/atmosphere model of the SAB.

OBJECTIVES

We are beginning implementation in this initial funding of the South Atlantic Bight Synoptic Offshore Observational Network (SABSOON). This involves design and deployment of the communications, power, data acquisition, and sensor carriage systems at as many of the eight offshore platforms as possible, and the development of an onshore data management and distribution system.

APPROACH

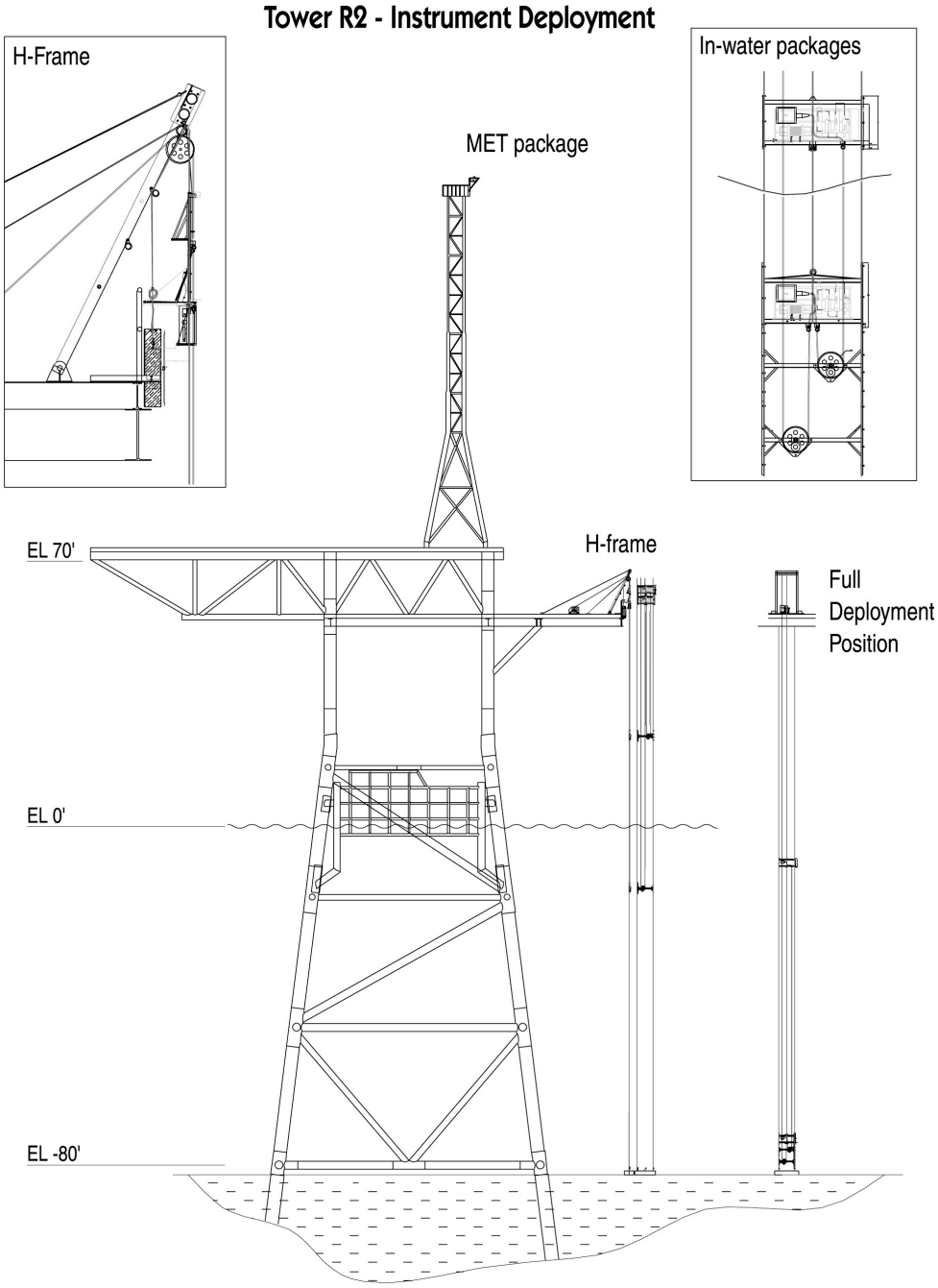
In collaboration with the southeast Tactical Aircrew Combat Training System (TACTS), eight offshore platforms owned and operated by the U.S. Navy are being instrumented with oceanographic and meteorological sensors. The effort involves interfacing science power and communications needs with TACTS existing equipment on the offshore platforms and at onshore installations. At each tower instrument systems are deployed which are for the most part readily serviced from the platform (i.e. there is not a need to use a ship or divers to service equipment). Power for the instruments is generated on-site, and data are relayed in real time by wireless communications to shore, though on-site storage is used to buffer the data and provide a backup in cases of communications failure. Once onshore, the observations are archived, processed, and distributed to various users who currently include academic researchers and the National Weather Service. Recent observations are also made available through a web site. The intent is to develop an offshore facility that can host a variety of scientific, educational, and environmental monitoring applications.

WORK COMPLETED

Phase 1 of the project, the design and deployment of prototype systems at one tower to test the concept, is complete. This work is largely the accomplishment of Travis McKissack, the chief engineer on the project, and the engineering staff at Skidaway Institute. Platform R2, the central master platform in the TACTS system, is fully instrumented. This includes a complete meteorological sensor suite (modeled after the IMET systems (Hosom et al, 1995)), near-surface and near-bottom SeaBird 37-SI conductivity/temperature/pressure sensors and Wetlabs dissolved organic matter (DOM) and chlorophyll-*a* fluorometers, and a near-bottom LICOR photosynthetically-available radiation sensor. A Paroscientific pressure sensor is rigidly attached to the platform to measure water level and surface gravity waves. A six camera underwater video system is deployed at an artificial reef near one of the towers (designed by Charlie Barans at the South Carolina Marine Resources Research Institute, a partner in the program) to monitor fish abundance and behavior. Data from all these instruments are relayed to shore over a wireless microwave system with a bandwidth equivalent to a T1 line, then through a dedicated phone line to the Skidaway Institute. Data transmission began in late May, 1999, and all systems were operational by late September, 1999.

Several challenges confronted us during this initial phase of the project. Concerns over power consumption occupied much of our early design effort; it was imperative that we not impact the Navy mission and we needed to design a complete system that would not impact their power systems. Interfacing to the existing microwave communications systems, which has a number of relay points and is now somewhat dated technology, required us to strike an agreement with the Georgia Air

National Guard as a location to pick up the dedicated phone line. A six-month delay in shipment of critical components (because they are hand-built) prevented us from bringing communications on line before May 1999. Vandalism of our in-water support system in June 1999 (someone cut the 5/16" stainless steel support cables) forced us to reinstall larger support stays (now 5/8" cabling), and because this required diver support, we were unable to accomplish this until mid-August. Hurricanes Dennis and Floyd prevented access to the platforms during late August and for much of September so that the in-water sensors were not deployed until late in the month.



Development of a data management system is ongoing. The current system records raw sensor output on Windows NT personal computers running Scientific Computing Software (SCS) on the offshore platforms. SCS is freeware developed by NOAA for acquiring shipboard observations, and we have found it to serve our needs quite well. These NT computers are connected to the Skidaway Institute local area network (LAN) through the microwave/dedicated phone line using TCP/IP communications protocols. Perl scripts which run hourly on a UNIX system at Skidaway maintain a copy of all raw data files on a RAID storage device, ensuring no data loss, even if the communication system goes down for an extended period of time (current maximum of 5 days). Automated processing of the raw files occurs periodically (hourly at present) which performs error checking, calculates derived quantities, and appends the observations to a database of processed observations. These data are then made available to the principal investigators in the program, and the most recent observations are posted on the web site.

At the bottom of the hour, meteorological and ocean surface observations which are of interest to the National Weather Service (NWS) are extracted from the database, formatted as CMAN data and sent via file transfer protocol (ftp) to the Jacksonville NWS office. There the data are passed through the World Meteorological Organization (WMO) gateway and made available globally. At present, only observations from platform R2 are transferred, but provisions have been made to make two other platforms reporting CMAN stations in the next 6-9 months.

Phase 2, the extension of the network to several other platforms, is now underway. Some new design work is required, principally the communications to the more remote platforms which do not have available bandwidth on their existing microwave communications system link to the master platforms. Our intent is to deploy an acoustic doppler current profiler (ADCP) at a second master platform (M2), and deploy a meteorological sensor suite and tide and surface wave sensor at the northeastern remote platform (R8). This will establish a link to a remote tower, and complete design and testing of all the major components necessary to fully instrument the network.

Dissemination of the observations to the various PIs in the project is ongoing. Guidelines for assessing the performance of the sensors are being developed. Also needed is feedback on the data distribution system in general. As the observational network expands, a modeling effort that includes data assimilation, lead by Cisco Werner, can now begin in earnest.

A component of the data assimilation system was tested in the field during cruises on Georges Bank in April-June of 1999 (with Cisco Werner and Brian Blanton at sea). The field experiments tested capabilities in assimilating shipboard ADCP data, drifter data and forcing by winds and heat fluxes obtained from large-scale atmospheric models. The idea of nesting a regional model within a large-scale model was also successfully tested. The SABSOON site and Georges Bank share key similarities that make the results on Georges Bank relevant to the development of assimilation capabilities for SABSOON. Both are coastal regions (on the order of 40-100m depth intervals), mixing is by tides and wind-forcing, heat-fluxes set up frontal structures and both sites are influenced by the presence of the Gulf Stream at the edge of the shelf. The model products provide every day a forecast for the three days that follow. Forecasts include the hydrography and stratification (salinity and temperature), current structure and associated turbulent fields, as well as sea level. The forecast included up to one week of hindcast and thus the entire simulation was commonly for 10 days. Comparisons with drifters (holey-sock and surface drifters) and dye dispersion resulted in a quantitative measure of error (predicted versus observed displacements) of about 3cm/sec for mid-water column locations. Given RMS velocities of roughly 40cm/sec, the results are very satisfying.

Testing at the SABSOON site will begin by implementing similar procedures at the University of North Carolina. Data from the towers and atmospheric forecast systems will be used in forcing the ocean hindcast and forecast (which will be initialized with climatological data until more complete hydrography is obtained).

RESULTS

We have demonstrated that the concept of instrumenting the Navy platforms is viable. Though it has taken some time to learn how to work with each other, we have developed an excellent working relationship with the personnel at TACTS and are in a strong position to move forward with the rest of the project.

The system for formatting and registering the observations with the WMO was devised with the help of Pat Welsh at NWS JX and Dave Gilhousen of the National Data Buoy Center (NDBC). The R2 platform is apparently one of, if not the first, automated marine weather reporting station in the United States which is not the direct responsibility of NDBC, and the collaboration may serve as a model for future coastal ocean monitoring systems to provide observations to the WMO. Gilhousen is presenting a paper on the concept at a meeting of the American Meteorological Society in Long Beach in January, 2000.

The meteorological observations are already yielding new insights into the coastal marine boundary layer. Thunderstorms over the shelf in mid-August when a front stalled over the Georgia coast produced 5 degC changes in air temperature in less than 6 minutes, implying severe downdrafts, and occurred repeatedly over a 4 day period. During calmer conditions, it is apparent that the sea breeze extends out to R2, more than 50 km offshore, and has a significant impact on the seas offshore, which also exhibit a daily cycle in amplitude. Analyses of nutrients from rainwater collectors suggest that atmospheric deposition may represent a significant source of nutrient input on the shelf.

IMPACT/APPLICATIONS

Full implementation of SABSOON will provide the scientific community, resource managers, and educators with real-time access to the coastal ocean. We feel this will enhance our understanding of the physics, biogeochemistry and ecology of the coastal zone, provide a monitoring system for coastal resources and coastal hazards, and a interactive observational system that can be used by educators to study coastal issues.

TRANSITIONS

At present, only the principal investigators and NWS are making use of SABSOON, but there have been more than half a dozen inquiries about using the observations in related studies, or about deploying specialized equipment on the platforms for add-on studies. We feel there is considerable potential for SABSOON to serve as an offshore research facility.

RELATED PROJECTS

Other partners in this NOPP-funded effort are Richard Bolin with TACTS in Beaufort, SC, Charlie Barans with the Marine Resources Division of the Department of Marine Resources in South Carolina, and Reed Bohne of the NOAA Gray's Reef National Marine Sanctuary (GRNMS). TACTS is the

outfit responsible for operating and maintaining the towers for the U.S. Navy. They are providing helicopter and technical support for the effort. Dr. Barans is a fisheries biologist and is using video monitoring to study fisheries in the South Atlantic Bight. GRNMS personnel have provided critical diving support.

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